

Analytical solution to 2D problem for an anticline-diverted brine flow with a floating hydrocarbon trap

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Abstract

Explicit rigorous solution to a steady-state J. Bear (Dynamics of Fluids in Porous Media. Elsevier, New York, 1972) problem of brine flow in an anticline homogeneous isotropic rock with a gas cap under the anticline crest is obtained by the methods of complex analysis. The stagnant hydrocarbon volume is separated from the subjacent moving brine by a sharp interface, which is a free boundary "hanging" in the formation with the loci of the anticline roof-attachment and roof-detachment points, as well as of an inflexion point, a priori unknown. Mathematically, a conformal mapping of the complex potential strip and integral representation of the Hilbert problem for the inversed complex Darcian velocity are used to obtain the physical coordinate, complex velocity and complex potential as functions of an auxiliary variable. The interfaces are plotted for various incident brine flow rates, angles of dipping anticline flanks and gas pressure. For a gas trap comparisons with the interface calculated by the Dupuit-Forchheimer approximation are carried out. © Springer Science+Business Media, Inc. 2007.

<http://dx.doi.org/10.1007/s11242-007-9110-y>

Keywords

Brine, Complex potential, Gas, Hodograph, Holomorphic functions, Hydrodynamic trap, Oil